Haryana Vet. (March, 2024) **63(SI),** 42-45

Research Article

EVALUATION OF BIOCHEMICAL PARAMETERS DURING DEXMEDETOMIDINE/ MIDAZOLAM IN DOGS UNDERGOING ELECTIVE OVARIOHYSTERECTOMY

ANJU POONIA[1], DEEPAK KUMAR TIWARI[1], SANDEEP SAHARAN*[2], SACHIN[1], NEERAJ ARORA[1] and SANDEEP KUMAR[3]
[1]Department of Veterinary Surgery and Radiology, [2]Department of Veterinary Clinical Complex
[3]Department of Veterinary Physiology and Biochemistry
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana-125004

Received: 26.05.2023; Accepted: 30.07.2023

ABSTRACT

The aim of the study was to investigate the suitability of dexmedetomidine and midazolam as pre-anaesthetics to the ketamine anesthesia combined dexmedetomidine/midazolam for dogs undergoing ovariohysterectomy. The present study was conducted on 28 female dogs irrespective of age, breed and body weight brought for elective ovariohysterectomy which were randomly divided into two groups comprising of 14 animals in each group. Sedation was achieved by administration of dexmedetomidine and midazolam in Group-I and II, respectively. Anaesthesia was induced with the help of ketamine and maintained with the help of dexmedetomidine/midazolam-ketamine. There was significant decrease in total proteins after sedation in both the groups. ALT, AST, ALP and cholesterol changed non-significantly in both groups as well as between the groups in comparison to respective base values during entire observation period. BUN and creatinine were significantly increased after pre medication, whereas significant decrease was observed in group-II after pre medication afterwards non-significant change was observed at the end of surgery. In group I, there was significant increase in LDH after pre medication from the base line value afterwards non-significant change was observed at the end of surgery. Thus, from the present study it was concluded that dexmedetomidine/midazolam provides better haemodynamic stability when used as a pre-anaesthetic for induction with ketamine in the dogs undergoing elective surgery.

Keywords: Dexmedetomidine, Ketamine, Midazolam, Ovariohysterectomy

How to cite: Poonia, A., Tiwari, D.K., Saharan, S., Sachin, Arora, N. and Kumar, S. (2024). Evaluation of biochemical parameters during dexmedetomidine/midazolam in dogs undergoing elective ovariohysterectomy. *Haryana Vet.* **63(SI)**: 41-45.

General anaesthesia is required in canines almost for all surgical procedures. Inhalation anaesthesia requires specific equipment and may only be possible under hospital conditions. It is rarely feasible for the use in the field. The adverse effects of atmospheric pollution and low-level personnel exposure to volatile anaesthetics must also be considered. A lot of new anaesthetic and analgesic medications are available, however none of them meet the criteria for the perfect anaesthetic and analgesic agent. Sedative and anaesthetic drugs have been used in conjunction broadly to obtain optimal analgesia, hypnosis and muscle relaxation (Verma *et al.*, 2018). Pre-anesthetic treatment has a direct impact on the anaesthetic dose that may result in the least complications due to low dose requirement of anaesthetic agent. Different sedatives are increasingly deployed as pre-anesthetic drugs, including xylazine, detomidine, dexmedetomidine, diazepam, midazolam, and butorphanol (Asif *et al.*, 2021). In order to achieve balanced anaesthesia in small animals, ketamine, an injectable dissociative anaesthetic, is frequently used in conjunction with alpha 2-agonists (El-Sherif, 2018).

MATERIALS AND METHODS

The present study was conducted on twenty-eight female dogs irrespective of age, breed and body weights brought to the Department of Veterinary Surgery and Radiology, College of Veterinary Sciences, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar for elective ovariohysterectomy. These animals were randomly divided into two groups comprising of fourteen animals in each group as mentioned below:

Groups	No. of animals	Premedication agents	Induction agent	Maintenance agent
I	14	Atropine (0.04mg/ kg b.wt. IM) Meloxicam (0.3 mg/ kg b.wt. IM) Dexmedetomidine (15 g/kg b.wt. IM)	Ketamine @ 5mg/kg b.wt. I/M Till effect	Dexmedet-omidine + Ketamine (1:1)
II	14	Atropine (0.04mg/ kg b.wt. IM) Meloxicam (0.3mg/ kg b.wt. IM) Midazolam (0.5 mg/kg b.wt. IV)	Ketamine @ 5mg/kg b.wt. I/V Till effect	Midazolam + Ketamine (1:1)

Biochemical Parameters: Three milliliters of blood was collected from cephalic vein pre-operatively, after 10 minutes of sedation and at the end of the surgery into a centrifuge tube without anticoagulant for separation of serum and separated sera samples were stored in aliquots in refrigerator at -20º C for biochemical analysis with helps of kits. Biochemical analysis was done using Erba kits through TRANSASIA - ERBA EM 200 automatic serum analyzer for the various biochemical parameters *viz.* Total

*Corresponding author: saharan007@gmail.com

proteins (TP), Albumin, Globulin, Serum alanine aminotransferase (ALT), Serum aspartate aminotransferase (AST), Blood urea nitrogen (BUN), Serum creatinine, Alkaline phosphatase (ALP), Lactate dehydrogenase (LDH), Serum glucose, Cholesterol, Calcium, Magnesium, Phosphorus, Sodium, Potassium and Chloride.

Statistical Analysis: The statistical analysis was conducted via SPSS software. Two-way ANOVA test was used to determine significant difference between different groups and between different time intervals. All the data values were expressed as Mean±SE and pair wise comparison was done using Duncan Test. P-values <0.05 was considered as statistically significant.

RESULTS AND DISCUSSION

The Mean±SE age and body weight of the dogs were 2.82 ± 0.55 years and 18.93 ± 2.14 Kg, respectively. All the dogs were female. The breed of animals was Pug, Pomeranian, Labrador (n=1, each) and Mongrel (n=11).

Mean±SE values of biochemical parameters at different time intervals are shown in Table 1.

Total protein (TP), Serum globulin and Serum albumin: In both the groups, there was significant decrease in total protein and globulin after pre medication from the base line value afterwards non-significant changes were observed at the end of surgery. The values of serum albumin changed non-significantly in group-I in comparison to base values during entire observation period. There was significant decrease in serum albumin values from the induction to the end of the surgery. The values of serum albumin changed non-significantly in group-II in comparison to respective base values during entire observation period. There were non-significant differences observed between the groups in total protein, serum globulin and serum albumin values throughout the observation period. Non-significant decrease in total protein was also observed during treatment with ketamine along with -2 agonist in canines by Umar and Adam (2013). This non-significant decrease in total protein in canines may be due to inter compartmental shifting of fluid, which might have caused haemodilution ultimately leading reduction to in serum protein. It might be also due to influx of fluid into vascular space (Bennet *et al.*, 2009).

This non-significant ($p<0.05$) decrease in total proteins might be due to increased concentration of glucocorticoids and increase adrenal activity and protein metabolism. Decrease in insulin and cortisol levels due to pre-anaesthetic and anaesthetic agents might modify the metabolism and reduce protein synthesis (Kaneko *et al.*, 2008). Mazumdar *et al.* (2015) also reported a non-significantly decrease in total protein in the dogs from 61.04±2.74 to 56.18±2.80 and from 62.42±3.10 to 58.77 ±3.03 following administration of dexmedetomidine @ 20 g/kg and 40 g/kg body weight intramuscularly, respectively.

This decrease in serum globulin and serum albumin was similar to protein and might be attributable to haemodilution due to continuous fluid therapy during the entire period of observation and shifting of ECF to the intravascular compartment to maintain normal CO during anaesthesia.

Serum aspartate aminotransferase (AST) and Serum alanine aminotransferase (ALT): The values of Aspartate aminotransferase and Alanine aminotransferase changed non-significantly in both groups as well as between the groups in comparison to respective base values during entire observation period. Sharma *et al.* (2014) also recorded a similar pattern of non-significant increase in serum ALT levels in the canines after systemic administration of dexmedetomidine. After dexmedetomidine and ketamine administration to dogs, non-significant changes in ALT/AST levels were observed (Saini *et al.*, 2019). Following diazepam premedication, a significant increase in ALT was seen at 30 and 60 minutes. This rise may be the result of enhanced permeability, which could allow enzyme leakage from cells with intact membranes. The enzyme escapes into the blood when there is stress or any type of injury to the liver cells, raising the ALT enzymatic activity (Yakubu *et al.*, 2020).

Blood Urea Nitrogen and Creatinine: In group-I, there was significant increase in BUN (Blood Urea Nitrogen) and Creatinine after pre medication from the base line value afterwards non-significant change was observed at the end of surgery, while group-II showed non-significant decrease in Creatinine and BUN (Blood Urea Nitrogen) after pre medication from the base line value afterwards non-significant change was observed at the end of surgery.

Our results were similar with the observation of Surbhi *et al.* (2010) was reported pre-medication with combination of butorphanol and xylazine or medetomidine caused non-significant decrease in serum creatinine. Dexmedetomidine and diazepam administration in goats resulted in non-significant change BUN and serum creatinine levels till the end of the observation period, indicating absence of renal failure (Ragab *et al.*, 2022). Ahmad *et al.* (2011) also reported that pre-medication with dexmedetomidine and butorphanol caused non-significant increase in serum creatinine. This increase might be due to decreased renal blood flow increased level of anti-diuretic hormone consequently decreased excretion of nitrogenous waste products as a result of decreased glomerular

Table 1. Biochemical parameters recorded at different time intervals (Mean ± SE)

Sero-Biochemical	Groups	Base Values (P)	After Pre-medication (T1)	At the End of Surgery (T3)
TOTAL PROTEINS (g/dL)	I	$5.67^{a,B} \pm 0.14$	$5.42^{A} \pm 0.16$	$5.2^{a,A} \pm 0.12$
	II	$6.38^{b,B} \pm 0.19$	$5.73^{A} \pm 0.17$	$5.70^{b,A} \pm 0.15$
ALBUMIN (g/dL)	I	$2.72^{AB} \pm 0.08$	$2.78^{B} \pm 0.10$	$2.50^{A} \pm 0.09$
	II	$2.80^{B} \pm 0.14$	$2.58^{AB} \pm 0.07$	$2.44^{A} \pm 0.07$
GLOBULIN (g/dL)	I	$2.96^{a,B} \pm 0.10$	$2.64^{a,A} \pm 0.15$	$2.74^{a,AB} \pm 0.15$
	II	$3.58^{b,B} \pm 0.21$	$3.15^{b,A} \pm 0.16$	$3.27^{b,AB} \pm 0.14$
ALT (IU/L)	I	18.01 ± 2.77	17.74 ± 1.49	14.6 ± 1.65
	II	25.77 ± 3.93	15.58 ± 1.71	14.83 ± 2.09
AST (IU/L)	I	22.66 ± 4.83	27.25 ± 4.35	18.66 ± 2.03
	II	31.96 ± 6.44	20.11 ± 2.98	15.96 ± 2.44
BUN (mg/dL)	I	$6.43^{A} \pm 0.73$	$8.24^{B} \pm 0.74$	$7.81^{AB} \pm 0.87$
	II	7.53 ± 1.56	5.68 ± 0.73	6.25 ± 1.02
CREATININE (mg/dL)	I	$0.48^{a,A} \pm 0.07$	$0.59^{B} \pm 0.04$	$0.5^{AB} \pm 0.07$
	II	$0.83^{b} \pm 0.09$	0.65 ± 0.12	0.64 ± 0.11
GLUCOSE (mg/dL)	I	$96.32^{B} \pm 6.22$	$100.75^{a,A} \pm 4.74$	$95.98^{B} \pm 6.54$
	II	106.33 ± 7.81	$107.97^{b} \pm 8.23$	127.56 ± 19.08
ALP (IU/L)	I	56.60 ± 20.46	42.44 ± 6.12	39.34 ± 6.67
	II	71.59 ± 20.66	39.32 ± 6.01	37.58 ± 7.67
LDH (IU/L)	I	$34.43^{A} \pm 2.67$	$41.07^{B} \pm 2.40$	$34.64^{A} \pm 1.87$
	II	40 ± 2.15	34.71 ± 2.20	35.43 ± 1.91
CHOLESTEROL (mg/dL)	I	145.07 ± 15.79	142 ± 14.17	$114.5^{a} \pm 15.88$
	II	170.36 ± 14.09	156.79 ± 15.79	$162.21^{b} \pm 14.68$
CALCIUM (mg/dL)	I	$7.72^{a} \pm 0.50$	8.11 ± 0.49	6.82 ± 0.70
	II	$9.94^{b,B} \pm 0.25$	$8.20^{A} \pm 0.74$	$8.14^{A} \pm 0.61$
MAGNESIUM (mg/dL)	I	$2.07^{a} \pm 0.09$	2.28 ± 0.13	2.07 ± 0.14
	II	$2.39^{b} \pm 0.07$	2.31 ± 0.08	2.2 ± 0.09
PHOSPHOROUS (mg/dL)	I	2.44 ± 0.53	3.04 ± 0.40	2.69 ± 0.32
	II	2.88 ± 0.23	2.28 ± 0.26	2.14 ± 0.31
SODIUM (mEq/L)	I	145.19± 2.30	142.94± 3.51	147.22± 2.41
	II	149.40±1.01	148.90± 1.68	147.99± 1.10
POTASSIUM (mEq/L)	I	5.01± 0.10	4.76± 0.18	4.57± 0.12
	II	5.24± 0.09	4.94± 0.13	4.86± 0.13
CHLORIDE (mEq/L)	I	83.60 ± 5.85	95.71 ± 2.71	89.71 ± 4.65
	II	87.66 ± 3.63	96.16 ± 2.43	99.71 ± 6.06

(Means with different superscripts (A, B)/ (a, b) varies significantly ($p<0.05$) within group/between group, respectively)

filtration rate (Kilic, 2008). Similar findings have also been reported by administration of xylazine and propofol in dogs (Cwiek *et al.*, 2009). In contrast with the present findings, BUN and creatinine was recorded to be significantly high in rabbit treated with xylazine-ketamine and ketamine-diazepam while did not show significant variables in rabbit treated with propofol (Mavadati *et al.*, 2011).

Our results were contrary to the observation of Jena *et al.* (2014) and observed that serum creatinine non-significantly decreased with pre-medication by dexmedetomidine accompanied by induction with propofol.

Alkaline Phosphatase, Lactate Dehydrogenase and Cholesterol: The values of Alkaline Phosphatase decreased non-significantly in both groups as well as between the groups in comparison to respective base values during entire observation period. In group-I, there was significant increase in lactate dehydrogenase after pre medication from the base line value afterwards non-significant change was observed at the end of surgery,

while in group-II there was non-significant decrease after pre medication from the base line value afterwards non-significant change was observed at the end of surgery. Mazumdar *et al.* (2015) reported that alkaline phosphatase level reduced significantly ($p<0.01$) in the serum in the dogs from 4.09±0.12 to 3.49±0.18 K.A. unit and 3.86± 0.09 to 2.70±0.06 K.A. unit in group-I and group-II, respectively following dexmedetomidine anaesthesia. This reduction might be due to the pre anaesthetic fasting of dogs which reduced the intestinal isoenzyme of alkaline phosphatase resulting in significant decrease (Kaneko, 2008). In contrast, alkaline phosphatase showed a non-significant increase at 10 min. of midazolam administration from the base value afterwards non-significant decrease at 5 min of ketamine administration (Kumar *et al.*, 2014).

The mean values of cholesterol decreased non-significantly in both groups in comparison to respective base values during entire observation period, while significantly higher at the end of surgery in group-II as compared to group-I. Similar results were observed by Reynolds *et al.* (2012), who observed a decrease in cholesterol values in cats after application of ketamine (10 mg/kg) and diazepam (0.5 mg/kg). According to Volpato *et al.* (2016), statistical differences were observed for cholesterol (P 0.001), FA (P=0.007) and glucose, with higher values being found under chemical containment in both the DB (P=0.017) and DBC groups as well as at the time of physical restraint (P<0.001) for the DBC group. However, Rovirosa-Hernandez *et al.* (2011) reported increase in cholesterol concentration induced by the use of ketamine (10-15 mg/kg) in primates. There is a conflict of results about this type of change, so further studies must be carried out.

Serum Glucose: In group-I, values of serum glucose increased significantly after premedication from the base values and at the end of the surgery there was non-significant decrease. The value of serum glucose in group-II was increasing non-significantly from the base value to the end of the surgery. Dexmedetomidine and diazepam administration in goats resulted in non-significant change BUN and serum creatinine levels till the end of the observation period, Similar to this, Kanda and Hikasa (2008) observed a non-significant rise in serum glucose following midazolam (0.5 mg/kg) administration. According to Arya *et al.* (2021) the administration of butorphanol-dexmedetomidine-ketamine was associated with a non-significant rise in glucose concentration. According to reports, ketamine causes sympathetic activation, which releases catecholamines and raises the plasma glucose levels. Hyperglycemia is caused by anaesthetics that enhance the adrenal cortex's release of the cortisone hormone during anaesthesia. According to (Restitutti *et al.*, 2012), hyperglycemia may be brought on by decreased glucose transport via the membrane, decreased glucose utilisation, impaired insulin activity, or an increase in adrenocortical hormone concentrations mediated by dexmedetomidine.

Calcium, Magnesium, Phosphorus, Sodium, Potassium and Chloride: The values of calcium changed non-significantly in group-I in comparison to respective base values during entire observation period. In group-II values of calcium decreased significantly after premedication from the base values and at the end of the surgery there was non-significant decrease.

The values of Magnesium and chloride changed non-significantly in both groups in comparison to respective base values during entire observation period and there was significant difference at base values between the groups.

The values of phosphorous, sodium and potassium changed non-significantly in both groups as well as between the groups in comparison to respective base values during entire observation period. Volpato *et al.* (2016) reported that there was non-significant increase in calcium, magnesium and chloride values in dexmedetomidine-butorphanol group after pre medication from the base values and then non-significant decrease after administration of dexmedetomidine-butorphanol and ketamine from the base values. However, these variables were within the normal range (Kaneko *et al.*, 2008), showing that physical restraint and stress that some animals suffered during immobilization, positioning and collection of samples were not able to change these exams. In contrast, Kumar *et al.* (2014) found non-significant increase in potassium, chloride whereas non-significant decrease in calcium, phosphorous, sodium and phosphorous values at 10 minutes of midazolam administration afterward there was non-significant decrease in calcium, potassium, increase in sodium and significant increase in chloride value after 5 minutes of ketamine administration in buffalo calves. Hyperchloraemia may be the result of change in relative water content of body or may be associated with compensated respiratory alkalosis as well as compensated metabolic acidosis (Carlson, 1989).

CONCLUSION

Dexmedetomidine causes a significant increase in glucose level but the changes were within normal clinical range. Thus, it is having hyperglycemic effect during the anaesthetic period. Both the premedicants causes significant decrease in total protein levels but changes were within normal ranges. Thus, from the present study it

was concluded that dexmedetomidine/midazolam provides better haemodynamic stability and are suitable when used as a pre-anaesthetic for induction with ketamine in the dogs undergoing elective ovariohysterectomy. But, from economic point of view midazolam is better as compared to dexmedetomidine.

REFERENCES

Ahmad, R.A., Amarpal, K.H., Aithal, H.P., Pawde, A.M. and Kumar, D. (2011). Effects of midazolam or midazolam-fentanyl on sedation and analgesia produced by intramuscular dexmedetomidine in dogs. *Asian J. Ani. Sci.* **5(5)**: 302-316.

Arya, N., Shukla, B.P., Jain, R., Rajput, N. and Parihar, A. (2021). Haemato-biochemical evaluation of glycopyrrolate, dexmedetomidine, butorphanol/buprenorphine as preanesthetic with ketamine dissociative anesthetic in canines. *Pharma. Innov.* **10(6)**: 803-807.

Asif, M., Khan, M.A., Akbar, H. and Omer, M.O. (2021). Effects of detomidine and midazolam administered alone or combined, on induction dose and quality of propofol and ketamine anesthesia in goats. *J. Anim. Plant Sci.* https://doi.org/10.36899

Bennet, J.S., Gosset, K.A., McCarthy, M.P. and Simpson, E.D. (2009). Effects of ketamine hydrochloride on serum biochemical and haematological variables in Rhesus monkeys. (*Macaca mulatta*). *Vet. Clin. Pathol.* **21(1)**: 15-18.

Carlson, G.P. (1989). Fluid, Electrolyte and Acid-Base Balance. In: Clinical Biochemistry of Domestic Animals, (4th Edn.), Academic Press, Inc. San Diego, California. p. 124.

Cwiek, A., Balicki, I., Rozanska, D., Poklowska, I. and Orzelski, M. (2009). Propofol-induced inhalation anaesthesia in dogs after xylazine or xylazine and midazolam premedicated. *Medyeyna-Weterynaryzna.* **65(1)**: 29-32.

El-Sherif, M.W. (2018). Evaluation of clinical anaesthetic effect after tramadol hydrochloride addition to xylazine-ketamine total injectable general anaesthesia in cats undergoing scrotal castration. *Indian J. Appl. Res.* **2**: 1-6.

Jena, B., Das, J., Nath, I., Sardar, K.K., Sahoo, A., Beuraand, S.S. and Painuli, A. (2014). Clinical evaluation of total intravenous anaesthesia using xylazine or dexmedetomidine with propofol in surgical management of canine patients. *Vet. World.* **10**: 2231-0916.

Kanda, T. and Hikasa, Y. (2008). Neurohormonal and metabolic effects of medetomidine compared with xylazine in healthy cats. *Canine J. Vet. Res.* **72(3)**: 278-286.

Kaneko, J.J. and Harvey, J.W. (2008). Clinical Biochemistry of Domestic Animals. (6th Edn.), California, Academic Press. p. 916.

Kumar, A., Kumar, A., Singh, S. and Chaudhary, R.N. (2014). Evaluation of midazolam-ketamine as an anaesthetic combination in buffalo calves. *Haryana Vet.* **53(2)**: 117-120.

Kilic, N. (2008). Cardiopulmonary, biochemical and haematological changes after dexmedetomidine-midazolam-ketamine anaesthesia in calves. *Bull. Vet. Inst. Pulawy.* **52**: 453-456.

Mavadati, A.H., Habibian, R. and Dehghani, S.N. (2011).Comparison of the effects of different anaesthetics on rabbit plasma biochemical parameters. *Res. Opinion Ani. Vet. Sci.* **1(6)**: 339-343.

Mazumdar, H., Sarma, B., Sarma, K.K. and Mazumdar, A. (2015). Haematobiochemical effecta of dexmedetomidine in dogs. *Int. J. Recent Sci. Res.* **6(7)**: 5301-5303.

Ragab, G., Hassan, S.E., Fathi, M.Z. and Hagag, U. (2022). Clinicophysiological and hematobiochemical effect of dexmedetomidine or diazepam with ketamine and propofol in total intravenous anesthesia in goats. *J. Basic Appl. Sci.* **11**: 54.

Restitutti, F., Raekallio, M., Vainionpää, M., Kuusela, E. and Vainio, O. (2012). Plasma glucose, insulin, free fatty acids, lactate and cortisol concentrations in dexmedetomidinesedated dogs with or without MK-467: A peripheral -2 adrenoceptor antagonist. *Vet. J.* **193(2)**: 481-485.

Reynolds, S., Geffré, A., Nathalie, H., Bourgès, A., Vaucoret, S., Maite, M., Braun, D. and Trumel, C. (2012). Effects of intravenous, low-dose ketamine-diazepam sedation on the results of hematologic, plasma biochemical, and coagulation analyses in cats. *J. Am. Vet. Med. Assoc.* **240(3)**: 287-293.

Rovirosa-Hernández, M.J., García-Orduña, F. and Caba, M. (2011). Blood parameters are little affected by time of sampling after the application of ketamine in black howler monkeys (*Alouatta pigra*). *J. Med. Primatol.* **40**: 294-299.

Saini, R., Jadon, N.S., Kandpal, M. and Kumar, A. (2019). Clinicophysiological and haematobiochemical effects of dexmedetomidine as preanesthetic in combination with thiopental sodium and ketamine in dogs. *Pharma Innov.* **8(7)**: 12-17.

Sharma, R., Kumar, A., Kumar, A., Sharma, S.K., Sharma, A. and Tewari, N. (2014). Comparison of xylazine and dexmedetomidine as a premedicant for general anaesthesia in dogs. *Indian J. Anim. Sci.* **84(1)**: 8-12.

Surbhi, Kinjavdekar, P., Amarpal, Aithal, H.P., Pawde, A.M., Pathak, M.C., Borena, B.M. and Malik, V. (2010). Physiological and biochemical effects of medetomidine- butorphanol, propofol anaesthesia in dogs undergoing orthopaedic surgery. *Indian. J. Vet. Surg.* **31(2)**: 101-104.

Umar, M. and Adam, M. (2013). Effect of combination of ketamine-medetomidine anesthesia on hematology and some serum chemistry parameters in dogs. *Niger. Vet. J.* **34**: 808-813.

Verma, K.K., Tiwari, S.K., Dewangan, R. and Sharda, R. (2018). Effect on haematological and biochemical profiles following administration of ketamine alone and in combination with dexmedetomidine or butorphanol in atropinized dogs. *Int. J. Curr. Microbiol. Appl. Sci.* **7(6)**: 2568-2577.

Volpato, J., Mattoso, C.R.S., Beier, S.L, Coelho, M.M., Tocheto, R., Ceregatti, M.G, Antunes, R.R., Costa, Á. and Saito, M.E. (2016). Effects of two sedation protocols in biochemistry variables in cats. *Arq. Bras. Med. Vet. Zootec.* **68(5)**: 1129-1136.

Yakubu, A.S., Usman, I.B., Kabir, H., Abubakar, A.A., Bello, A., Oviawe, E.I., Abubakar, N. and Bodinga, H.A. (2020). Effects of lignocaine - diazepam combination in lumbo-sacral epidural anaesthetized dogs undergoing caudectomy. *J. Advances Bio. Biotech.* **23(2)**: 11-18.